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Summary and Implications

Objectives of this study were to compare cow comfort and animal behavior (postural changes) as well as leg health and determine behavioral alterations in cows housed on sand or mattresses, and then switched to the alternate surface in a tie stall barn. During experiment 1 (new mattresses), there were significant differences in posture with cows on mattresses lying more than sand stalls. Two years later (Experiment 2), using a switchback design (animals were evaluated on one surface, then switched to the other), there were no differences in posture scores between mattresses and sand, and more variation was seen across weeks within surface type than across surface types indicating other factors affect cow posture in stalls. Animals housed on mattresses in both experiments had significantly higher hock scores (hock abrasions). When mattress animals were switched to sand, hock scores improved slowly. This work substantiates that either stall surface will work and be comfortable (especially compared to previous alternatives) but stall maintenance (sand quality, sand grooming, and especially adequate bedding on top of mattress top covers) is critical for stall comfort success.

Introduction

A great deal of concern is allotted toward dairy cow comfort in order to optimize both cow welfare and milk production. Toward this end, producers are utilizing various stall surfaces in order to optimize cow comfort, while at the same time decreasing health concerns. Many existing tie stall barns have challenges associated with this since stall dimensions may be inadequate due to the origin of the facility, or 4-6 " of bedding is required for cushion above concrete stall surfaces and either minimal bedding is used and / or maintained under animals to provide this (both capital and labor required). Sand or a variety of mattresses (some type of filling or stuffing with a top cover) have been developed and used in free stalls to provide adequate comfort and health. These materials have the potential for use in tie stall barns. Sand is very comfortable (gold standard) but offers some labor and manure handling challenges. Most mattress materials can now be fabricated to fit existing stalls and top cover materials can be cut and molded around existing stalls and pipes. Although mattresses provide 3-4" of cushion, adequate bedding materials are required on the mattress surface to expedite moisture absorption and provide cushion from animal joint friction and abrasion from the top cover surface. Concerns and questions have arisen regarding the comfort of mattresses compared to sand. The objective of this study was to compare cow comfort and animal behavior (postural changes) as well as leg health and determine behavioral alterations in cows housed on sand or mattresses, and then switched to the alternate surface in a tie stall barn.

Materials and Methods

Two experiments were conducted using tie stalls (4.5' X 6.5') which were either bedded with sand (4-6") or used a multi celled mattress filled with crumb rubber (4-5") and a fabric top cover (Pasture Mat, Promat Ltd., Ontario, Canada) for the stall surface (n = 12/trt.; only 8 /trt. for video analysis). Animals were housed in the stalls at least one week (3-4 weeks in Experiment 2) prior to trial initiation and remained in those stalls and barn for the trial duration. Animals were milked twice daily (2 hours out of stalls) and also had another 4 hour exercise period where they were outside, so they spent ~ 18 hours /day in the tie stalls. Two cameras (one for each side or surface) were mounted 7" high at the end of each row of stalls, and connected to a time lapse video VCR recorder on 48 hour mode. Video data was continuously collected for 17 d (Exp. 1), when the mattresses were new, and then again, two years later, for a 22 d period (Exp. 2) to record cow position. During Exp. 2, video data was collected for 8 days, cows were then moved and switched to the alternate flooring (other side), and video data was again collected 6 d later for an 8 d duration. Cow posture was recorded as 1) cow lying on right side; 2) cow lying on left side; and 3) cow standing. In the final analyses, postures 1 and 2 were combined to compare lying and standing, and data were totaled by hour, normalized, and evaluated using ANOVA with repeated measures.

A leg or hock scoring system (1-5) based on evaluation of the hock area was developed to assess surface comfort and abrasiveness. Scores were: 1. Normal hock with no evidence of any damage or hair alteration; 2) evidence of hair covering rustled or rubbed off; 3) hair rubbed off to the skin surface but skin intact; minor swelling; 4) swelling; laceration or compromise of skin tissue; and 5) swelling and abscessed. Hocks were evaluated weekly for a 2 month period during experiment 1 and scored prior to movement to the alternate surface and weekly (3 weeks) after movement in Experiment 2.

Results

Postural scores for cows housed on mattresses or sand for both experiments are shown in Table 1. Cows on the mattresses were more likely to be found lying ($p < .001$) compared to cows on sand in experiment 1. This may partially be explained by the new mattresses (no compression of crumb rubber yet) or sand consistency (stalls filled with sand from pile that had been partially frozen). There were no significant differences in posture scores between mattresses and sand in experiment 2. There were, however, significant differences in posture scores between weeks in Experiment 2.

Average leg (hock) scores for cows housed on mattresses or sand in the tie stall barn for Experiment 1 are shown in table 2. Cows housed on mattresses had significantly higher hock scores across all dates as compared to sand. This may be explained by the abrasiveness of the new mattress top cover and / or insufficient bedding (~ 1.5 pounds / cow / day). Average leg (hock) scores for cows housed on mattresses or sand in the tie stall barn for Experiment 2 are shown in Table 3. Cows housed on mattresses had significantly higher hock scores as compared to sand prior to switching stalls and surfaces. There were no significant differences in hock scores between sand and mattresses at three weeks following the stall switching. However, animals originally on sand and switched to mattresses showed significantly higher hock scores (1.00 vs. 1.79) while animals on mattresses and switched to sand saw hock score improvements (2.33 vs. 1.75). Percentages of cows (hocks) with a score ≥ 2 were 0,0; 58,58; 67,54, and 58,50 for cows originally on sand, on mattresses, switched from sand to mattress, and switched from mattresses to sand.

During experiment 1 (new mattresses), there were significant differences in posture with cows on mattresses lying more than sand stalls. However, one week acclimation time may have been too short to see the impact of mattresses on decreased leg health and posture. Two years later (Experiment 2), using a switchback design (animals were evaluated on one surface, then switched to the other), there were no differences in posture scores between mattresses and sand, and more variation was seen across weeks within surface type than across surface types indicating other factors affect cow posture in stalls. Animals housed on mattresses in both experiments had significantly higher hock scores (hock abrasions). When mattress animals were switched to sand, hock scores improved slowly. Recent work from Wisconsin shows animals that are lame (slight to severe) stand more in free stalls. This work does not show that (similar lying time) and may result from the tie stall which limits the ability of the animal to choose stalls and may mask true preferences or behavior. This work substantiates that either stall surface will work and be comfortable (especially compared to previous alternatives) but stall maintenance (sand quality, sand grooming, and especially adequate bedding on top of mattress top covers) is critical for stall comfort success.

Table 1. Postural scores* for cows housed on mattresses or sand for 2 experiments.

	Mattress	Sand
Experiment 1: 17 days	$1.99 \pm .009^{a}$	$2.32 \pm .008^{b}$
Experiment 2: First week	$1.76 \pm .01$	$1.82 \pm .01$
	One week after switchback	
Experiment 2: Third week	$1.91 \pm .01$	$1.90 \pm .01$

*Score of 1=lying left, 2=lying right, and 3=standing. ^{a,b} $p < .001$

Table 2. Average leg (hock) scores* for cows housed on mattresses or sand in a tie stall barn for Experiment 1.

Date →	3/31	4/7	4/14	4/20	4/28	5/5	5/11	5/18	5/25
Mattresses	1.33^{a}	1.33^{a}	1.375^{a}	1.33^{a}	1.33^{a}	1.21^{a}	1.25^{a}	1.29^{a}	1.50^{a}
Sand	1.04^{b}	1.04^{b}	1.04^{b}	1.00^{b}	1.00^{b}	1.00^{b}	1.00^{b}	1.00^{b}	1.00^{b}

* 1. Normal hock with no evidence of any damage or hair alteration; 2) evidence of hair covering rustled or rubbed off; 3) hair rubbed off to the skin surface but skin intact; minor swelling; 4) swelling; laceration or compromise of skin tissue; and 5) swelling and abscessed. ^{a,b} $p < .01$

Table 3. Average leg (hock) scores* for cows housed on mattresses or sand in a tie stall barn for Experiment 2.

Date	Mattress	Sand
Experiment 2: 3/19	$2.33^{a\,c}$	$1.00^{b\,c}$
Three weeks after switch: initial mattress cows on sand and vice versa		
Experiment 2: 4/14	1.79^{d}	1.75^{d}

* 1. Normal hock with no evidence of any damage or hair alteration; 2) evidence of hair covering rustled or rubbed off; 3) hair rubbed off to the skin surface but skin intact; minor swelling; 4) swelling; laceration or compromise of skin tissue; and 5) swelling and abscessed. ^{a,b} within row $p < .01$ c,d diagonal cells since animals switch surfaces $p < .01$